diverge before they reach the object; and it may be remarked generally that the definition of objects is always most perfect, when an illuminating pencil of suitable form is accurately adjusted to focus, that is, so that the source of light and the plane of vision may be conjugate foci of the illuminator. If an object-glass of 120° aperture or upwards be used as an illuminator, the markings of Diatomaceæ will be scarcely distinguishable, with any object-glass; the glare of the central rays overpowering the effects of structure on those that are more oblique.

XVI. "On the Constitution of Coal-tar Creosote." By Professor Williamson. Communicated by Dr. Sharpey, Sec. R.S. Received June 15, 1854.

For some years past it has been a debated question among chemists, whether the peculiar body originally described by Reichenbach as creosote, and subsequently analysed by Ettling and others, has any real existence, or whether the properties which were attributed to it are not to be more correctly ascribed to the hydrate of phenyl, which can be obtained in a state of great purity from at least one sort of commercial creosote by mere distillation, and which possesses in an eminent degree the antiseptic properties for which creosote is remarkable.

With a view of obtaining some light on this question, Mr. Fairlie undertook, in the laboratory of University College, an investigation of the portions of coal-tar creosote which boil higher than the hydrate of phenyl. The result of his experiments has been to show that a body homologous to hydrate of phenyl may be obtained from the crude creosote, in fact the next term of the series above hydrate of phenyl itself. Some qualities of commercial creosote contain a greater quantity of this *hydrate of cresyl* (as it may be termed) than others; and it is most advantageously prepared from those portions which in the first distillation come over between 200° Cent. and 220°. After a great number of fractional distillations, a colourless, highly dispersive liquid is obtained, boiling at 203° Cent., and possessing the composition represented by the formula $C_{14}H_8O_2$.

This hydrate of cresyl resembles the corresponding phenyl compound in most of its properties; but it may be easily distinguished from that compound by its almost complete insolubility in aqueous ammonia.

When gradually mixed with sulphuric acid, it becomes of a beautiful rose-colour, and gives rise to sulpho-cresylic acid.

The action of nitric acid upon hydrate of cresyl is very violent, and almost explosive if the acid is used in a concentrated state and at so high a temperature as the common atmospheric; even very dilute nitric acid transforms the compound into a brown tarry mass from which no definite substance can be extracted. By cooling some nitric acid in a frigorific mixture and allowing some similarly cooled hydrate to fall into it drop by drop and with constant agitation, a red-coloured solution was obtained, which by dilution with water and subsequent neutralization by potash yielded a crop of short needle-shaped crystals of an orange-red colour, and possessing a greater solubility in water than the salt of carbazotic acid. This salt was found by analysis to possess the composition of a homologue of carbazotate of potash; so that it is the potash salt of a hydrate of cresyl in which three atoms of hydrogen are replaced by hyponitric acid,

$$C_{14}\genfrac{}{}{0pt}{}{H_4}{(NO_4)_3}O, KO.$$

The same acid was obtained by the action of nitric acid upon an alcoholic solution of the hydrate containing urea; but in attempting to repeat this experiment on a larger scale the mixture became hot, and the whole of the substance was destroyed with almost explosive violence.

When treated with pentachloride of phosphorus this hydrate of cresyl is decomposed in like manner with the hydrate of phenyl, as described by Mr. Scrugham, yielding a chloride of cresyl and a phosphate of the same radical.

By the action of this phosphate in an alcoholic solution of acetate of potash, a peculiar oleaginous body is obtained possessing an odour entirely different from that of the hydrate, and decomposable by potash with production of acetate and cresylate.

A similar reaction ensues when the phosphate is distilled with ethylate of potash, and a cresylate of ethyl is thus obtained.

In the numerous distillations which were performed for the purification of the hydrate of cresyl, some circumstances were observed which led to a suspicion that the body undergoes a change of composition, either through the distillation itself, or by some influences accompanying it. These circumstances were,—1st. A tarry residue, from a liquid which when introduced into the retort was perfectly colourless. 2nd. The formation of a small quantity of water in the commencement of such a distillation, though none was contained in the substance used. 3rd. The gradual lowering of the boiling-point of the whole liquid by a great number of distillations. These facts, taken in conjunction, naturally suggested that the oxygen of the air contained in the retort might act upon the substance, and thus gradually reduce it to hydrate of phenyl.

In order to test the correctness of this hypothesis, the atmospheric air was expelled from the distilling apparatus by dry hydrogen gas, and the distillation performed in a pure atmosphere of this gas. A great number of distillations performed in this manner were at exactly the same temperature, and all the other anomalies were simultaneously removed. It was however found that the liquid always boiled at a lower temperature in hydrogen than in atmospheric air, the difference being about 2° Cent., and this without any alteration of the pressure on the surface of the boiling liquid. A similar fact was noticed in the distillation of hydrate of phenyl, and also of some other liquids.

XVII. "On the Formation of Powers from Arithmetical Progressions." By C. Wheatstone, Esq., F.R.S. Received June 15, 1854.

The same sum n^a may be formed by the addition of an arithmetical progression of n terms in various ways. Hence we are enabled to construct a great variety of triangular arrangements of arithmetical progressions, the sums of which are the natural series of square, cube and other powers of numbers. Among these there are several which render evident some remarkable relations.